Previous generations of cardiologists have advocated medical management of severe AS until symptoms are well established. It was stated in a recent editorial, "We, like most cardiologists, no longer believe that surgery is the most common cause of sudden death in asymptomatic patients with aortic stenosis."[16] Results of the present study support the idea of early intervention in patients with a diagnosis of severe asymptomatic AS when there is a low institutional perioperative mortality. It is possible that future studies that include risk stratification will improve patient selection for AVR.

Conclusions

At 3 years, 52% of asymptomatic patients with severe AS had symptoms develop, had AVR, or had died. Patients with severe AS who present without symptoms do not have greater operative and long-term mortalities if they undergo elective AVR after the development of symptoms. Importantly, however, patients who had symptoms and patients who remained asymptomatic and had AVR had a survival advantage when compared with asymptomatic patients who had medical management alone.

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Discussion

Dr Michael A. Acker *(Philadelphia, Pa).* This paper is very important. I believe its import lies not in the extraordinary low mortality, for which the Mayo cardiac surgeons are to be congratulated, but rather in this very careful observation of the natural history of asymptomatic AS and also the similarities in the operative mortality between the asymptomatic and symptomatic patients undergoing AVR. I have three questions, which I will ask one at a time to give you a chance to answer.

Although you showed overall survival and benefit for just getting the valve replaced, 50% of your patients remained asymptomatic without AVR and without death at 3 years. Did you look at this group to determine preoperative characteristics such as the presence of left ventricular hypertrophy, for instance, that would be predictive of a benign course so that we do not have to operate on everyone who has severe AS?

Dr Brown. We did not specifically look at that group of patients. However, in a previous study, both a smaller aortic valve area and left ventricular hypertrophy predicted symptom development in patients with asymptomatic AS.

Dr Acker. Second question: As you know, the operative mortality across the country for AVR and aortic valve and coronary bypass surgery, according to The Society of Thoracic Surgeons database, is not 1% and 2% but rather 3.5% for AVR alone and nearly 6% for an AVR/coronary bypass. It is thus imperative, if one is considering operating on the asymptomatic patient, to know the true operative result. On the other hand, to complete that risk/benefit analysis, one would have to know the rate of sudden death if we are going to wait in the asymptomatic group and the factors that would predict sudden death. Do you have some information on that?

Dr Brown. I cannot help you with the factors that will predict sudden death; however, I can tell you that the rate of sudden death in this cohort was approximately 1% per year. As you can see, with an operative mortality of 1%, it is a reasonable decision to operate in these patients.

Dr Acker. Finally, did you look at the need for coronary bypass surgery or the ischemic burden as an independent risk factor for the development of symptoms or long-term survival?

Dr Brown. Again, we did not specifically look at patients who did or did not have coronary artery bypass grafting except for in our multivariate model.

Dr Paul Kurlansky *(Miami, Fla).* You demonstrated very nicely that AVR was an independent risk factor for lower mortality, but obviously both in the symptomatic and the asymptomatic patients, the decision not to operate was based on many factors. Did you use propensity analysis or any other method to try to match patients who did not have surgery with patients who did have surgery to see whether you could discern other independent factors that would have led to the decision not to operate?

In other words, it would seem as though merely waiting and watching is not necessarily a wise decision, but that is not necessarily the decision that was made. The decision not to operate may have been a conscious one based on other risk factors that may

themselves have been predisposed to mortality. Therefore, the decision not to operate is really a surrogate for other factors. I was wondering whether you used any statistical method to try to explore this.

Dr Brown. No, we did not use any type of statistical methods such as propensity matching. The problem is that trying to identify retrospectively why patients did not have surgery is always difficult, and as mentioned, our beliefs are that there are several reasons. Some patients are not referred, some patients are elderly and frail and do not wish to have surgery, and some patients, of course, have cancer or dementia, which may preclude an invasive procedure.

Dr Wade L. Knight *(Temple, Tex).* I noticed from the summary in the book that you did not include anyone in your group with an ejection fraction less than 40%. Admittedly, that makes your statistics look better in your outcomes, but I think what those of us in the audience need to know is what do the real life group of patients look like? Many of the people that might have been turned down for surgery may have been turned down because of low ejection fractions or high creatinine values. You are probably familiar with the article in the December 2006 issue of *The Annals of Thoracic Surgery*, I think out of Loma Linda, addressing the large percentage of patients with AS turned down or never referred for aortic valve surgery. At your institution, did you refuse AVR for patients with ejection fractions less than 40%, or did you just not include them in this report?

Dr Brown. Just to make it clear, of the original cohort of patients who were identified with asymptomatic AS, only 3% had an ejection fraction of less than 50%. We did not specifically exclude any patient simply for having a low ejection fraction in our surgical series.

Dr Ahmed El Gamel *(London, United Kingdom).* The question of mortality from your paper is quite clear: you have a low operative mortality. However, one question that bothers me is the morbidity of replacing a valve in a patient who is asymptomatic. Complications like stroke, even if it is a minor one, will make the patient stay in the hospital for a period of time. Have you any feeling of how much morbidity the asymptomatic patients have experienced and how long the hospital stay was for patients who needed readmission for any complications after surgery?

Dr Brown. We do not look at specific data on the length of stay after surgery. As was shown, the mortality after surgery is similar to that of an age- and gender-matched population. However, you are correct; we did not specifically look at the burden of morbidity in a patient who receives an AVR.

Dr Christopher M. Feindel *(Toronto, Ontario, Canada).* When determining whether patients have symptoms or not, was there consistency in obtaining a good history? I know that sounds pretty basic, but I think if you question patients you will often pick out symptoms that, believe it or not, even the cardiologist might not pick up.

Dr Brown. This study stretched over a long period of time, beginning in 1984, and there was no systematic objective assessment such as an exercise stress test. However, a cardiologist did review all these patient charts to determine that this was an actual asymptomatic patient.

Dr A. W. Atkinson *(Raleigh, NC).* I think it is an interesting study and it is sort of a negative study. It shows that symptoms do not really predict the outcome of surgery. You would think otherwise, that the more symptomatic patients are going to have a little tougher time or a higher mortality, but that is not true. It seems that it is very subjective, and I think we need to be much more definitive. We have seen this with mitral valve disease; lots of asymptomatic people's ventricles are deteriorating. It has been my impression that people are fairly asymptomatic, but a lot of these people are not very active. They do not do a whole lot and the biggest thing in their life is to get surgery. We really need more objective criteria than just how the patient feels according to a telephone call or when they visit the doctor. When they are afraid of surgery, they are not going to have many symptoms. I think we need numbers like Bonow's mitral valve data, as someone mentioned, left ventricular hypertrophy, pulmonary artery pressures, left atrial size, presence or absence of atrial fibrillation. There are a whole lot of criteria that we need to put on these patients and see what they have, when they have it, do they have it, and then I think we will have a lot more sorting out as to when we need to operate on these patients.